

MANAGING HEALTH INFORMATION IN CHAD:
A MODEL OF TECHNOLOGY TRANSFER FOR DEVELOPING COUNTRIES?

By

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Comments appreciated

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ABSTRACT

National management information systems do not constitute a single coherent technology. The factors which facilitate the transfer of these systems are different from those identified in the literature as facilitating the transfer or diffusion of technologies. In the case of Chad's management information system for its Health Ministry, the primary facilitating factor was the consensual process by which the Ministry developed the configuration of its information system. Technological issues were subservient to the organization of an environment in which information could be collected, analyzed, and used.

INTRODUCTION

Information systems do not constitute a single coherent technology. They are complex mixtures of technologies (computer hardware and software) and methods of organization (management systems). Aside from the choice of computer hardware and software, there are no standard ways of building information systems. They are not procedures such as coronary artery by-pass operations, nor equipment such as ultrasound machines. They are not a new seed for third-world farmers, nor birth control methods for harried mothers.

The thesis of this paper is that successful management information systems are unique to their environments and that the critical factor in their implementation is the process by which they are adopted. Thus, it is irrelevant to look for models of technologies which can be transferred to third-world countries. The crucial element in successful adoption is the **process** of development that occurs within the management environment implementing the system. Modeling the adoption process may prove more fruitful than modeling the technology.

This paper is in three parts. Part I examines briefly the characteristics of existing national health management information technology. Part II describes the unique national information system developed, with technical assistance, by Chad's Ministry of Public Health from 1985-1988. Part III examines the Chad experience in the light of theories of technology transfer and diffusion.

I. WHAT TECHNOLOGY ARE WE TRYING TO TRANSFER, ANYWAY?

National or public health management information systems are not a single technology. They differ from country to country depending upon historical accident and the interests of policy makers, administrators, and researchers. They comprise both routine and periodic data collection.

Not all the data presently used for health management were originally collected for that purpose. The decennial census in the United States was established by the Constitution to allocate seats in the House of Representatives, but it serves as the demographic denominator for a wide variety of social, economic, and health indicators. Vital statistics recording (births, deaths, marriages), was originally the task of local churches in Europe concerned with maintaining information about their congregations. Churches in the Scandinavian countries with official state religions, maintained this task until recent years. In the United States, the state recording of vital statistics did not become a national system until 1933 when the last state entered the system.

The United States has one of the best developed national public health information systems and it is worth noting its complexity and variety to understand how diffuse the term "health information systems" is. A compendium of public health data sources in the United States identified 107 publicly available sources of data on mortality, morbidity, natality, maternal and child health, health care, demography, and nutrition (11). These

were drawn from routine reporting systems (including vital records), periodic health surveys, and the Census. The routine data collection includes vital records, reporting of specific disease incidence and mortality to the Centers for Disease Control, work accidents reports, Medicaid and Medicare utilization and expenditures, and hospital discharge data. The periodic surveys include health interview and examination surveys on disease prevalence, disability, nutrition, and behavioral risk factors. These data are collected by physicians, hospitals, government agencies, and survey organizations. They are processed almost entirely by government agencies.

Other developed countries may have similarly structured information systems, but exhibit considerable variety in their content, methods of organization, and methods of analysis. In reviewing national health interview surveys in nine developed countries, Kars-Marshall et al. (14, 224) found, for example, "there are as many different types of surveys as there are countries conducting such an interview survey."

Information systems have a technical and an environmental component. Today, the technical component is computer hardware and software now in common use in both the first and third world. The microcomputer, because of its small size, low cost, and flexibility has been promoted as being particularly appropriate for third-world information systems. (1) Yet, most countries had developed national health information systems long before the advent of computers, attesting to the primacy of system

development over the technology.

The environmental component of national information systems has five characteristics. First, these systems have been developed ad hoc over time in response to demands from data users. In the developed world, the creation of redundant systems has been not infrequent, resulting either in eventual mergers or in conflicting data from competing agencies. Thus, these systems are idiosyncratic to the countries which develop them. There are no international norms (and probably should not be). The World Health Organization (18, 23) has developed guidelines, for example, for information systems for indicators for monitoring health care and although its documents and the organization insist that these are merely guidelines, technical advisors and third-world government officials all too easily assume that these are the standards to be adopted by every country.

Second, these systems have, for the most part, been created by government agencies to permit them to assess needs for planning (health surveys, notifiable disease reporting, vital statistics), or to manage programs (Medicare and Medicaid). Private and voluntary agencies have rarely succeeded in establishing viable national information systems, though frequently, some system that they have begun to set in place, may later be taken over by public agencies.

Third, the purposes and hence, formats of systems may change over time. For example, Medicaid information systems were originally established to assist the federal government to

monitor only the flow of funds. When it became clear that utilization and the quality of care needed also to be monitored, the system had to be modified. Retooling systems to fit new uses may be necessary, but not necessarily implemented.

Fourth, the quality of the data collected and analyzed in these systems varies greatly. As an editorial in The Economist (7) stated, this can result in "Numbers not worth crunching." As information systems get more institutionalized, questioning their validity or reliability becomes more difficult. On the other hand, when competing agencies produce conflicting data, and when there is no national arbiter and no national standard, data produce as much confusion as none at all.

Fifth, all these systems are costly. This seems like stating the obvious, but when one is talking about developing systems for third-world countries, cost is perhaps the most relevant issue. In countries where the annual government health budget is less than \$20 million and where more than three-quarters of this is supplied by donors, the establishment of a routine reporting system costing \$100,000 annually or the launching of a one-time health survey costing \$500,000 is no trivial matter.

II. DEVELOPMENT OF A NATIONAL HEALTH INFORMATION SYSTEM FOR CHAD

A. The Problem

Chad, by any measure, is one of the poorest countries in the world. In 1982, it began to emerge from nearly twenty years of civil war, a war which had destroyed infrastructure, killed

thousands, and sent many of the elites into exile. And while the fighting ended at home, it continued until 1988 with neighboring Libya. Even with massive efforts at national reconciliation, the reconstruction of a country which had never been well favored by nature nor by its colonizer proceeded slowly.

The health sector had been as hard hit by the civil turmoil as other sectors. Rehabilitation depended on the infusion of foreign aid with donor assistance accounting for 66 percent of the health budget in 1985 (and growing to 87 percent by 1989) (18). By 1985, although most facilities had been rehabilitated, they were scarcely adequate to provide basic health services and were chronically short of trained staff (only 75 Chadian physicians for a population of five million). Public hospitals lacked basic equipment such as beds and x-ray machines, while smaller clinics were without routine essentials such as soap.

More problematic for the Ministry of Public Health was the organization of health services since trained personnel were in short supply. Although the Ministry administered 75 percent of health facilities and employed more than 90 percent of health personnel in the country, and although vestiges of earlier information systems continued to operate in a desultory manner, the Ministry could not muster reliable data on any aspect of its own activities and facilities, much less on those of the private sector (which administered nearly 50 percent of facilities in the populous south). Nor could the Ministry estimate whether its activities were meeting health needs because the sparse

epidemiological data collected were so unreliable.

In short, The Ministry lacked the information it needed for planning and management. To solve this problem, it sought the support of USAID which from 1985 to 1989 provided technical assistance through the Harvard Institute for International Development (HIID) providing for three long-term advisors. With this support, the Ministry could now turn to developing a viable comprehensive health information system that would improve its capacity for planning and management.

B. Process of Health Information System Development: the consensual approach

With the encouragement of the technical assistance team, the Ministry and particularly the Director-General under whose aegis this system would be developed, made two strategic decisions. The first was to proceed by a consensus of users and collectors of data; the second was to design the system on the basis of the expressed information needs of health administrators and planners.

Chadians, whether by tradition or by legacy from the colonial period, adhere to strictly hierarchical relations in governmental affairs. However, this hierarchical approach is tempered by a style of decision making that is found throughout the government and in traditional settings, as well. This style is that all opinions should be heard before a decision is reached. In theory, these opinions, once expressed, can then be ignored in the decision, but often, as in the case of development

of the information system, the frank and vigorous discussions within the setting established for decision-making served to shape the outcome. The setting for debate was a Commission on the health information system (CSIS) which the Director-General established in late 1985 and whose task it was to recommend a new information system to the Ministry.

The Commission included the directors of all seven Divisions of the Ministry, the directors of special programs (maternal and child health, nutrition, etc.), a regional medical officer (medecin-chef), and representatives of the major donors who delivered health services in Chad (Catholics, UNICEF, Swiss Aid, etc). The Director-General asked a newly formed unit under his office, the Bureau of Statistics and Planning, to serve as secretary to the Commission. Since this Bureau now housed the USAID supported project with three HIID advisors, it also had the means to perform secretarial services, e.g. the only functioning copier in the Ministry.

The decision making process was complex, as illustrated in Figure 1, with the Commission (CSIS) serving as the central forum for debate. The Director-General, although a non-participant in the CSIS, maintained close contact with the Bureau of Statistics, the HIID team, and the individual members of the Commission. He provided frequent feedback and commentary on the proposals as they developed.

The Commission members were surveyed as to their needs for data, the means they proposed for obtaining them, and their

assessment of the degree of difficulty in obtaining such data reliably. Program managers and planners expressed their needs not in terms of explicit models of the minimum package of activities necessary for appropriate health services, but in terms of desired objectives and the means of measuring the achievement of those objectives.¹ From this survey, the HIID team prepared a synthesis of information needs and an option paper, proposing different ways of meeting these needs.²

The discussions on the design of the system were long and occasionally heated. They extended over 14 months and through several sub-commissions. As the work progressed, the HIID team's main task became to help the participants search for areas of consensus.

The final choices for the information systems involved many compromises. No one got exactly what he wanted, but when the system was adopted, everyone, from the Minister on down, had agreed to it.(10;9) This high level of consensus was essential to the system during its first years of implementation, as program directors, medecins-chefs (district doctors), and health facility personnel struggled to adapt to a new system which restructured bureaucratic relationships. The utility of the approach was not lost on Ministry directors. In early 1987, when a new Minister of Public Health met with senior Ministry officials and donor representatives to review donor projects, each project received careful scrutiny and heavy criticism from officials. The one exception was this Information System Project

whose exposition was received in silence. When the Minister solicited comments from the assembled officials, he too, was met with silence until a senior director volunteered to the new Minister that this particular project had been so thoroughly discussed within the Ministry that there was no need for commentary. Everyone knew what was going on and approved.

Once the Ministry had approved the information system design, the Bureau of Statistics, with the HIID team, designed and pre-tested the reporting forms, produced the final forms, and organized over two years national and regional training seminars.

By 1989, 90 percent of all health facilities were sending monthly reports regularly (at least 85 percent of expected reports) to the Bureau of Statistics. The Bureau produced statistical yearbooks using data on health needs, health facility activities, and resources for the first year of full reporting (July 1987-June 1988) and for the calendar years 1988 and 1989. It also produces monthly tables for the immunization program on its immunization activities, as well as tables for other programs, as needed.

C. Structure of the Information System

The information system that emerged had elements of systems found in other countries, but the particular combination of elements was unique to Chad. The system is at least as idiosyncratic as those found in any developed country. It provides much less information than that recommended by international agencies (see, for example, reference 23), but it

satisfies short-term needs of Chadian managers and planners, while laying the basis for a long-term system. Moreover, because the demands of the system are relatively modest, it may be able to function within Chad's severe budgetary constraints.

First, Chad's information system is a national comprehensive integrated routine reporting system. Integrated means that the system replaced all pre-existing program-based reporting systems for vertical programs, such as immunizations, maternal and child health, nutrition, etc. This required considerable consensus among the different programs that their needs could be met by an integrated system. Unsurprisingly, this was a politically touchy issue. The Director-General had to do much negotiating, cajoling, and pressuring to achieve a satisfactory compromise. Integrated also means that data processing is carried out centrally by the Bureau of Statistics (BSPE) where the Project installed five micro-computers to permit more rapid data entry and analysis. Again, this involved getting the program directors to agree to obtain their data via the Bureau of Statistics rather than directly from the health facilities as they had attempted to do in the past. Comprehensive meant that private as well as public facilities were incorporated into the reporting system.

Second, the system is based entirely on routine monthly reports from health facilities on their activities and the diseases treated. There is also an inventory of personnel and equipment which is, in theory, annual, but was collected only once, in 1988. Data collected by the routine reporting system

can be supplemented by surveys, but the primary focus is routinely collected data from health facilities. This decision was made for two reasons: first, since the main objectives for central and regional Ministry officials on the CSIS were to have data for managing health facilities and services, data from these facilities were essential; second, Chad, at the time, had neither the resources nor the personnel for instituting the types of surveys necessary to provide adequate surveillance of activities and health needs.³ The Commission assumed that, in the future, when resources were available, surveys could be used to supplement the routine data bases.

Third, the structure of the information system reinforced the existing or planned administrative structure. The Ministry took advantage of the new information system to reinforce both the Bureau of Statistics in the central Ministry and the newly designated medecins-chefs (district health officers) whose tasks were to manage all health services within their regions. Under the information system, the medecin-chef became the official responsible for overseeing the collection of data in the localities. This gave him a clear supervisory task and the ability to oversee health workers in his district.

Fourth, the type of information gathered was designed to accommodate the skills of collectors, rather than just the needs of the users. Since most of Chad's more than 400 health centers are run by nurses with scarcely a junior high school education and with only a thermometer as their diagnostic tool, diseases

had to be reported by signs and symptoms, and reporting forms had to be very easy to fill out. As a result, the Commission debated lengthily what indicators would be appropriate, valid, and reliable. Following international diagnostic coding would have produced unreliable results because the diagnostic capacity was so limited. As a result, Chad collects data on relatively few disease entities, but has more valid and reliable information on those diseases it follows.⁴ Nurses also report on only a limited number of their activities. So far, these limitations have posed no problems for Chadian planners, but they do irritate international organizations which have their own bureaucratic imperatives.

D. Secrets of Success: Strengths and Weaknesses

The creation of an environment favorable to its development has proved critical to Chad's information system. The primary environmental component has been the use of a consensual process which involved both collectors and users of data in the information system design. Collectors could be reassured that what they were collecting had some purpose for others (and for themselves); users were forced to scrutinize what data they needed and exactly how they would use it to plan and/or manage. By having to forge compromises, by having to sit opposite the table of their competitors for data, both users and collectors became aware of the complexity of the issues involved and that playing a zero-sum game with their colleagues in the Ministry would not prove productive. As they became aware that the system

would be tailored, in so far as possible, to their data needs and to their collection capacity they gained some confidence in the proceedings.

A second important environmental element was that the information system was tailored to reinforce the administrative structure. The Ministry had undertaken an administrative reform just as discussions on the information system were getting underway. It was this reform that was implemented along with the information system. However, one should have no illusions that this was a smooth process. The administrative reforms involved downgrading some cherished and ancient directorates (e.g. Grandes Endemies) and upgrading others (e.g. Bureau of Statistics). Program directors were nervous about the future of their programs. The director of the immunization program (EPI) was particularly reluctant to allow "his" data to be collected by the Bureau of Statistics, but he was reassured that the Bureau would make the data available to his staff on a monthly basis. By 1989, when the immunization program director was feeling dissatisfied with being dependent on the Bureau for data (which it termed inaccurate), it launched, at some cost, its own surveys of immunization coverage. As it turned out, the surveys produced results not significantly different from those produced by the routine reporting system. This put a temporary damper on program attempts at independent data gathering, but highlighted the continual tension between program and central interests in an integrated system. It is likely that program directors will

continue to make attempts to establish independent data bases, particularly through surveys, given that donors are always so enthusiastic to provide support for these activities.

In the administrative reorganization, the medecins-chefs had been given increased responsibilities and, as a consequence, were responsible for assembling and sending on the monthly reports from health facilities. However, in 1986, these administrators still had no administrative support, no vehicles, no administrative assistants, and no statisticians, so that the Bureau of Statistics was mandated to process all data and to provide rapid feedback. As it turned out, the Bureau has not been able to provide rapid feedback, causing frustration among the medecins-chefs, who, with technical assistance, eventually began to develop some capacity for data analysis in their own region. Thus, the system, as designed, incorporated sufficient flexibility to permit a shift in the locus of data analysis as the capacity grew in the regions.

Providing support for these environmental components of consensus and administrative restructuring was the leadership provided by the Director-General throughout the period of development and implementation of the information system. Leadership has been frequently cited as factor in technology transfer. In the case of Chad's system, it was crucial. The Director-General who strongly favored an integrated comprehensive information system, was able to mobilize staff and negotiate a consensus. That his activities were not entirely disinterested

was evident since he would be one of the main beneficiaries of the new system, both through his access to reliable data, and through the strengthening of the Bureau of Statistics which was under his office. Nevertheless, the vigor with which he applied himself was important in moving along the design and development process. It also meant that when the system was ready to be instituted, it received high national priority from political officials and considerable publicity. National seminars were presided by the Minister and Director-General; regional seminars were presided by the administrative prefects and the medecins-chefs.

Less critical, but also important for the environment, was the role of the HIID technical assistants who participated in the design process as facilitators. They assisted Commission members to search for areas of compromise. Their primary tasks were to listen, make suggestions of possible solutions to problems, and to abandon their own preconceived notions of what an information system **should** look like. This was not always easy, but was accomplished sufficiently that the system that emerged was viewed by the Ministry and health workers as being ^{the} work of the Commission and not that of the technical assistants. Technical assistance was also important for another reason: the availability of supplies and a copier through the Project's budget prevented the Commission's deliberations from faltering for lack of paper or copies, such as occurred regularly in the rest of the Ministry.

The technical components of the system received considerably less attention, but also proved less troublesome, except perhaps for training. Although the technical assistance team began training Bureau of Statistics workers in computer use from the time the first computers arrived (and before the reporting system had been put in place), the lack of highly trained programmers in the public service system as a whole, was a permanent problem and fostered a continuing dependence.

To mitigate this problem, the Ministry had selected its hardware and software to maximize compatibility and simplicity. The five IBM computers and two Bernoulli boxes eventually acquired were identical to those already operating in the Ministry of Plan. Software was standard, off-the-shelf DBase III+, WordPerfect, Epi-Info, and Lotus 1-2-3. Nevertheless, programming capacity was needed to create DBase data entry screens and output tables for the information system, and this continued to be done by a technical assistant for the first four years. A second concern for sustainability was the capacity to maintain the hardware and software. Surveillance and maintenance requires highly developed management skills and a hierarchy that encourages initiatives by managers. This environmental element continues to impinge on what otherwise would be a relatively simple technology to install and maintain. Thus, the success of the technical component remains dependent on the success of establishing a suitable management environment in which it can flourish. The problems remain environmental, not technical.

III. TECHNOLOGY/INNOVATION TRANSFER AND DIFFUSION; THEORY AND PRACTICE

In Part I, I suggested that management information systems are not one single technology. Nevertheless, the adoption of a new management information system is an innovation, if not a single technology. In Part II, I showed how a third-world country, Chad, innovated to produce its own idiosyncratic information system. In this section, I will examine theories on innovation diffusion to see what light they shed on this process.

Early studies of innovation diffusion focused on the characteristics of the individual adopter, such as the farmer who decides to plant a new hybrid corn or a villager who adopts new birth control methods, with nearly one-third of these studies taking place in third-world countries (20). Since information systems are group undertakings, such a conceptual focus has little relevance in this case.

Later studies, particularly in medical innovation, focussed on the structure of organizations as the relevant factors in explaining, for example, why certain hospitals are more likely than others to adopt a new technology (21;13). Such analyses were carried out with other types of innovations in other organizational settings, such as state governments (17). Given the variability in governmental organizations across the world, such an approach may be perhaps too broad for examining national health information system innovation.

The third approach has been one of analyzing the socio-economic-politico-cultural environment in which the adoption of innovation takes place. Brodman (5) has shown that leadership, the power structure, and incentive systems are all important to the development of management information systems, while Auxilla and Rohde(3) have emphasized the detrimental effects of frequent personnel shifts and laxity of management. This approach is clearly relevant to the Chad experience.

The fourth approach has been to analyze the technology itself to assess its "appropriateness." For example, when high milk producing cross-bred cows were rejected by Indian farmers, analysts said the technology was inappropriate because the farmers wanted cows which could serve as draft animals as well (2). The problems of a management information system in Uganda were attributed, among other things, to poor choices of hardware and software (19).

These approaches have been criticized by Rogers (20, 90-92) in that they do not consider the innovation as a process rather than as a single event, and by Bonair et al. (4, 774) for failing to integrate all these approaches when evaluating factors favoring the diffusion of innovations.

Judging from the Chad case, process itself may become the most important factor in determining the successful innovation of a management information system. The requirements for this environmental process were strong leadership, modification of the administrative structure, and the establishment of a forum within

which the Ministry could achieve a consensus among users and collectors of data.

Students of innovation, in the future, could profitably study not just the characteristics of the environment (what factors foster innovation?), nor just the characteristics of a technology (is it appropriate?), but the characteristics of the process of innovation adoption and implementation (how were users involved? what effect did this have on the character of the innovation, as adopted?). In studying a management information system, the questions would be: how were collectors and users of data involved? how were indicators selected? how was the flow of information established?

Reports of information systems developed in other countries suggest that Chad's experience may not be unique, although its information system is. However, the appropriate forum for consensus will inevitably vary among different types of governments, and the types and locus of leadership may vary, too.

Is the Chadian management information system a model of technology transfer for developing countries? No, not the system itself. Each country must design its own systems if it wants to collect data useful for its own planners and managers. However, the design and implementation process can be modeled. It is here where technical assistance can be helpful by making available to a country or to a Ministry, the resources and the time to design its own system. Ultimately, however, the success of such an innovation will depend upon the leadership a country or a Minister provides for this process.

END NOTES

1. Unger (22), who favors the explicit model approach, acknowledged that, in the case of Chad, the results were similar to those which would have been achieved using an explicit model because the decision makers were operating under an implicit model. I would argue that using implicit models may create an information system with greater flexibility in adapting to the realities on the ground.

2. For details on this process, see references 10; 12.

3. This decision to favor routine reporting systems over surveys has been supported by several studies. For example, Kok (15) found that the usual techniques of cluster sampling for immunization coverage surveys were carried out in such a way so as to produce overestimates of coverage, while Cutts (6) found that repeated surveys for measles incidence were inappropriate and less effective than routine reports for evaluating immunization program impact in Mozambique.

4. For more detail on the indicators and reporting forms, see references 8; 12.

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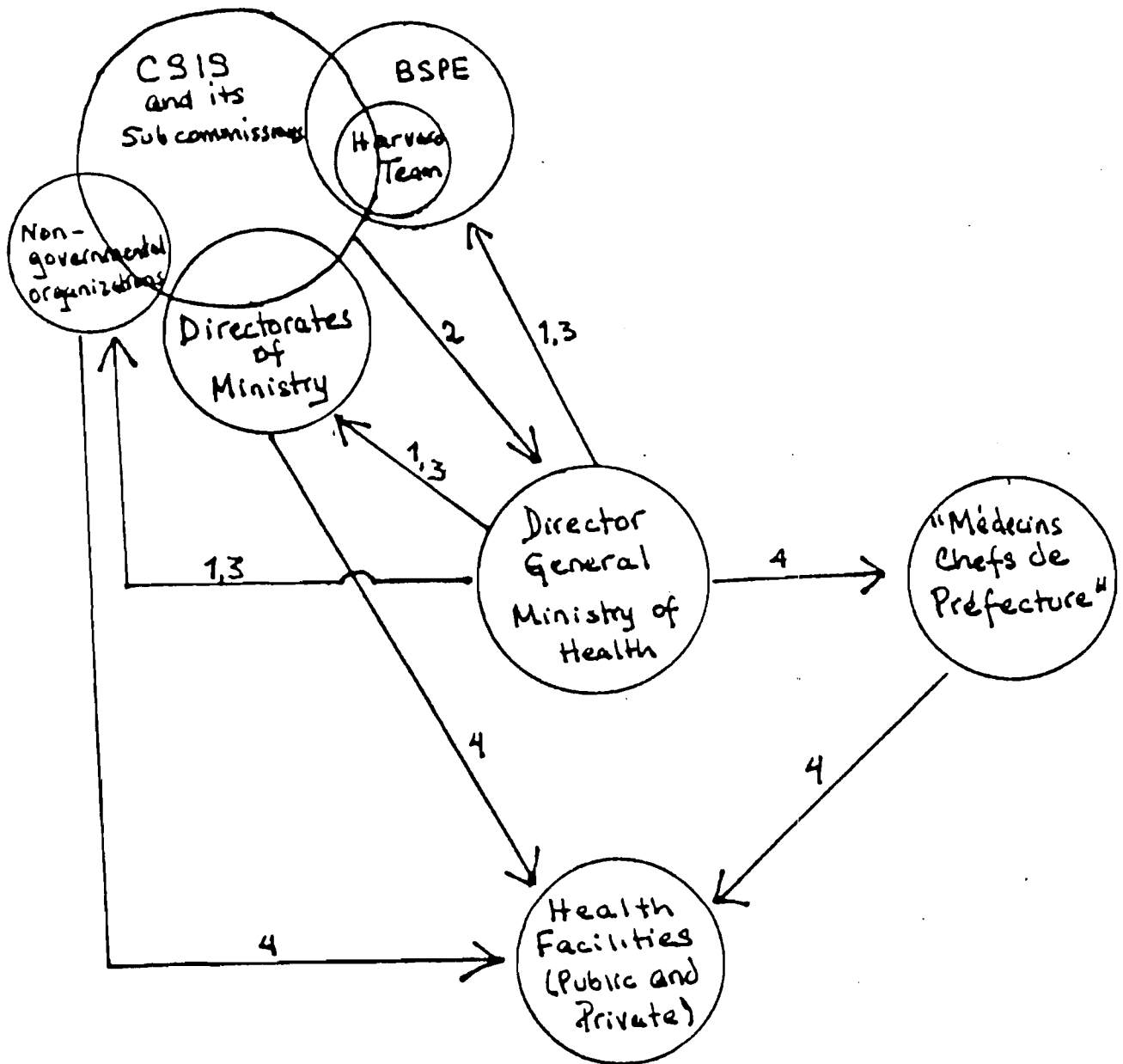
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Figure 1

Decision-making process for the Health Information System



LEGEND:

○ Principal Participating Organizations

→ Direction of Decision or Recommendation

1, 2, 3, Sequence of Decisions or Recommendations

CSIS = Commission du Système d'Information Sanitaire

BSPE = Bureau de Statistiques, Planification, et Etudes